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(54) Title: TOUGH, WEAR- AND ABRASION-RESISTANT, HIGH CHROMIUM HYPEREUTECTIC WHITE IRON

(57) Abstract

A tough, wear- and abrasion-resistant, high chromium, hypereutectic white iron alloy, with a composition by wt.% of >4.0 C, 25-45 Cr, 0-15 Mn, 0-10 Mo, 0-10 Ni, 0-2 B and 0-5 of at least one of Ti, W, Ta, V and Nb, subject to the proviso that Ti + W + Ta + V + Nb = 15 max., the balance, apart from incidental impurities, being Fe. The recommended super-heating range is 20-100°C above the liquidus for a particular composition, for pouring prior to casting to a minimum thickness of 10 mm. The microstructure is characterised by a volume fraction > 20% of primary, acicular, M_7C_3 - type carbides of mean cross-sectional dimension of 75μ max. in a eutectic matrix of eutectic and secondary carbides and austenite and/or martensite. The alloy in its softest condition, exhibiting stabilised austenite, substantially free of martensite, has a hardness of about 450 HV; in the as-cast state, the hardness typically ranges from 600-700 HV; after appropriate heat treatment, (e.g. heating at 900°C for 2-3 hours, followed by furnace or air cooling), the hardness range can be increased to 850-900 HV. The hardened alloy can be applied to such wear-and abrasion-resistant components as grizzly bars, hammer tips in hammer mills, sinter blow bars, coal and bone pulverisers, slurry spray nozzles and lining plates in chutes and crushers. The above components are typically assembled in the form of composites, with a copper liner at the interface, either by vacuum brazing pre-cast alloy on to, or casting in situ on or around, a strong and tough metallic substrate.

The claims defining the invention are as follows:-

1. A tough, abrasion resistant ferrous alloy comprising a cast hypereutectic white iron having in excess of 4.0 wt.% carbon, from 25 to 45 wt.% chromium and:

0 - 15 wt.% manganese,

0 - 10 wt.% molybdenum,

0 - 10 wt,% nickel,

0 - 2 wt.% boron,

0 - 5 wt.% of at least one carbon forming element selected from titanium, tungsten, tantalum, vanadium and niobium, the balance apart from incidental impurities being iron; the total of said at least one carbide forming element being not more than 15 wt.%; the alloy as cast having a minimum thickness dimension of at least 10 mm, and a microstructure comprising a volume fraction in excess of 20% primary carbides of acicular M_7C_3 type and a matrix of eutectic composition; the primary carbides of the M_7C_3 type substantially throughout the alloy having a mean cross-sectional dimension of not more than 75μ.

2. A ferrous alloy as defined in claim 1, wherein there are at least two of said carbide forming elements to a total of at least 10 wt.%, and at least 5 wt.% manganese.

3. A ferrous alloy as defined in claim 1 or claim 2, wherein there is at least one of manganese and nickel present at a respective level of not less than 2 wt.% and 4 wt.%.

4. A ferrous alloy as defined in any one of claims 1 to 3, wherein there is from 1 to 2 wt.% boron and at least 5 wt.% manganese.

5. A ferrous alloy as defined in any one of claims 1 to 4, wherein there is from 1 to 2 wt.% boron and at least 5 wt.% manganese.

6. A ferrous alloy as defined in claim 1, wherein said matrix is characterized by eutectic carbides and a mixture of austenite and martensite, plus secondary carbides.

7. A ferrous alloy as defined in claim 6, wherein there is from 40 to 60% of one of austenite and martensite relative to the other.

8. A ferrous alloy as defined in claim 1, wherein said matrix is characterized by eutectic carbides, austenite and secondary carbides substantially in the absence of martensite.

9. A ferrous alloy as defined in any one of claims 1 to 8, wherein carbon is present at from 4.0 to 7.5 wt.%.

10. A ferrous alloy as defined in claim 9, wherein carbon is present at from 4.5 to 5.5 wt.%.

11. A ferrous alloy as defined in any one of claims 1 to 10, wherein chromium is present at a level of at least 30 wt.%.

12. A ferrous alloy as defined in claim 11, wherein chromium is present at from 30 to 40 wt.%.

13. A ferrous alloy as defined in any one of claims 1 to 12, wherein there is from 1 to 5 wt.% of at least one of titanium, tungsten, tantalum, vanadium and niobium to a total not in excess of 15 wt.% and added as fine particulate carbide to the melt from which said alloy is cast.

14. A ferrous alloy as defined in any one of claims 1 to 13, wherein there is up to 2 wt.% boron added as fine particulate boron carbide to the melt from which the alloy is cast.

15. A ferrous alloy as defined in any one of claims 1 to 14, wherein there is from 1 to 10 wt.% molybdenum added as fine particulate molybdenum carbide to the melt from which the alloy is cast.

16. A ferrous alloy as defined in any one of claims 1 to 15,